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FOCUSED FEASIBILITY STUDY FOR SITE 19 SMALL ARMS RANGE 910 NSTC GREAT LAKES IL

10/1/2012

TETRA TECH

Focused
Feasibility Study
for
Site 19 – Small Arms Range 910

Naval Station Great Lakes
Great Lakes, Illinois

Naval Facilities Engineering Command
Midwest

Contract Number N62467-04-D-0055

Contract Task Order 468

October 2012

061011/P

FOCUSED FEASIBILITY STUDY

FOR

SITE 19 – SMALL ARMS RANGE 910

NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Midwest
201 Decatur Avenue, Building 1A
Great Lakes, Illinois 60088

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ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chemical of concern
CSF	Cancer Slope Factors
CTE	Central Tendency Exposure
FFS	Focused Feasibility Study
GRA	General Response Action
HI	Hazard Index
HQ	Hazard Quotient
ICMP	Illinois Coastal Management Plan
ILCR	Incremental Lifetime Cancer Risk
Illinois EPA	Illinois Environmental Protection Agency
LUC	Land use control
MCL	Maximum Contaminant Level
mg/kg	Milligram per kilogram
MOA	Memorandum of Agreement
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPW	Net Present Worth
PEF	Particulate Emissions Factor
PAH	Polynuclear aromatic hydrocarbon
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI/RA	Remedial Investigation/Risk Assessment
RME	Reasonable Maximum Exposure
SSL	Soil Screening Levels
TACO	Tiered Approach to Corrective Action
TBC	To be considered
µg/kg	Microgram per kilogram
USC	United States Code

USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

This Focused Feasibility Study (FFS) was prepared for Site 19, Small Arms Range 910, at the Department of the Navy's Naval Station Great Lakes, Great Lakes, Illinois, under Contract Task Order 468. Figure 1-1 shows the location of Site 19. The FFS Report was prepared in accordance with the United States Environmental Protection Agency's (USEPA's) Comprehensive Long-Term Environmental Action Navy IV Contract Number N62467-04-D-0055 and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Guidance for Conducting Remedial Investigations and Feasibility Studies (1988).

1.1 SITE CHARACTERIZATION

1.1.1 Location and Description

Site 19 is the location of the former Recruit Training Center Rifle Range housed within Building 910. The site is bounded on the north by 4th Avenue, on the east by Ohio Street, and on the south and west by grass and concrete associated with other buildings. Site 19 is currently an open, grassy area. Figure 1-2 shows aerial photographs of the site in 2000, when the building was still located at the site, and in 2008, as the site currently exists. Figure 1-3 is a recent site photograph from May 2012. A former dry cleaning operation was located approximately 50 feet southwest of Site 19.

1.1.2 History

Site 19 was an indoor rifle range that operated between 1942 and 1997 and was demolished in 2000. It is estimated that 19 million pounds of ammunition were generated by this facility, providing the potential for lead to have impacted site soil and groundwater. Chemicals used at the rifle range include CLP brand cleaner and standard issue bore cleaner #6850-00-224-6663. These chemicals are primarily composed of petroleum products and distillates [i.e., volatile organic compounds (VOCs) and polynuclear aromatic hydrocarbons (PAHs)]. The use of these chemicals provides the potential for VOCs and PAHs to have impacted site soil and groundwater.

A dry cleaning facility was located just southwest of former Building 910. A Resource Conservation and Recovery Act (RCRA) storage unit and tanks were located at the northern end of the dry cleaning facility, approximately 80 feet southwest of Site 19. Soil contamination associated with the dry cleaning operation has been documented, and these contaminants (i.e., chlorinated VOCs and their byproducts) may be present in soil and groundwater at Site 19.

1.2 ENVIRONMENTAL CONDITIONS

The following briefly reviews the Remedial Investigation/Risk Assessment (RI/RA), which characterized conditions at the site as of December 2008. More detailed information is available in Sections 4.0, 6.0, and 7.0 of the RI/RA (Tetra Tech NUS, Inc., 2010).

1.2.1 Nature and Extent of Contamination

The following summarizes the nature and extent of the current contamination in groundwater, surface soil, and subsurface soil at Site 19:

Groundwater – Two monitoring wells were installed and sampled at Site 19. No contaminant concentrations were identified at levels above federal or state drinking water standards. The limited nature of contaminant concentrations in groundwater indicate that potential leaching of contaminants from soil to groundwater is not a significant concern at the site.

- Low-concentration VOCs, specifically acetone and toluene, were detected in the groundwater below Site 19. Concentrations were observed at levels below risk-based screening concentrations, and did not exceed regulatory criteria based on the Illinois Environmental Protection Agency (Illinois EPA) Tiered Approach to Corrective Action Objectives (TACO) Tier 1 Groundwater Remediation Objectives and federal Maximum Contaminant Levels (MCLs).

- Low-concentration PAHs, including but not limited to benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene were detected in the shallow groundwater at Site 19. Several detections exceeded screening concentrations but did not exceed regulatory criteria based on Illinois EPA TACO Tier 1 Groundwater Remediation Objectives and federal MCLs.

- Arsenic was detected above a non-regulatory screening level in one of the two wells. However, the concentration detected was well below the Illinois EPA TACO Tier 1 Groundwater Remediation Objective and the federal MCL for arsenic.

Surface Soil - 16 surface soil samples (plus two duplicate samples) were collected from 15 surface soil sample locations. Two VOCs, 2-butanone and acetone, were detected in surface soil. No detections exceeded risk-based screening criteria or regulatory criteria based on Illinois EPA TACO Tier 1 Objectives. The presence of acetone in samples could be attributable to lab contamination.

- Multiple PAHs, including, but not limited to, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene, were observed consistently in surface soil across the site. PAH concentrations exceeded screening criteria and Illinois EPA TACO Tier 1 Remediation Objectives for Residential Incidental Ingestion. However, PAH concentrations in surface soil that exceeded TACO Tier 1 objectives were below background concentrations established by the Illinois EPA for soil in counties within the Metropolitan Statistical Area.

- Inorganic contaminants, including arsenic and manganese, were observed in surface soil at concentrations above risk-based screening levels and Illinois EPA TACO Tier 1 Remediation Objectives for Residential Incidental Ingestions. In addition, concentrations of manganese exceeded the Illinois EPA TACO Tier 1 Remediation Objective for Construction Worker Soil Inhalation.

Subsurface Soil - 22 subsurface soil samples (plus one duplicate sample) were collected from 18 soil borings.

- Three VOCs (4-methyl-2-pentanone, trichlorofluoromethane, and acetone) were detected in subsurface soil. No detections exceeded risk-based screening or regulatory criteria based on Illinois EPA TACO Tier 1 Objectives.

- Multiple PAHs, including, but not limited to, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, were observed consistently at low concentrations in subsurface soil across the site. Concentrations of benzo(a)pyrene and benzo(a)pyrene equivalents exceeded risk-based screening levels. However, no subsurface concentrations exceeded Illinois EPA TACO Tier 1 Remediation Objectives.

- Inorganic contaminants, including arsenic and manganese, were observed in subsurface soil at concentrations above risk-based screening levels and Illinois EPA TACO Tier 1 Remediation Objectives for Residential Incidental Ingestions. In addition, concentrations of manganese exceeded the Illinois EPA TACO Tier 1 Remediation Objective for Construction Worker Soil Inhalation.

1.2.2 Human Health Risk Assessment

The Human Health Risk Assessment identified contaminants as chemicals of concern (COCs) based on a non-cancer Hazard Index (HI) greater than 1.0, or Incremental Lifetime Cancer Risks (ILCR) greater than $1x10^{-6}$ in soil and in groundwater that may potentially be used as drinking water. The following contaminants were retained as COCs:

- arsenic
- manganese
- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- chrysene
- dibenzo(a,h)anthracene

These are the primary COC risk drivers for future residents. Groundwater at the site is not used and is not expected to be used in the future as drinking water. Naval Station Great Lakes is an active Navy facility and is expected to remain active for the foreseeable future. In accordance with Naval Station Great Lakes Instruction 11130.1 dated September 29, 2003, use of groundwater and surface water runoff within all geographical areas of the base, for any purpose, is strictly prohibited without prior written approval. Groundwater underlying Naval Station Great Lakes is not used for drinking water and is not expected to be used in the future.

No chemicals in soil were eliminated as COCs on the basis of comparisons to background concentrations. The PAHs selected as COCs in exposed surface soil had maximum detected concentrations that did not exceed surface soil background data, as shown in the Table 1-1 below. Based on this information and the Illinois EPA determination of urban PAH background concentrations, it is possible that these PAHs could be attributed to background conditions, and inclusion of these chemicals as COCs may result in an overestimation of total risks for this site.

The inorganic contaminants, arsenic and manganese, were also retained as COCs. The average arsenic concentration was below the Illinois EPA background level of 13 milligrams per kilogram (mg/kg) for both surface and subsurface soil, as shown in Table 1-1. The average concentration of manganese in surface soil exceeded the Illinois EPA background level (Table 1-1).

TABLE 1-1

SITE 19 CHEMICALS OF CONCERN

COCs	Surface Soil Average/ Maximum	Subsurface Soil Average/ Maximum	Illinois EPA Background Soil	Illinois EPA TACO Residential Direct Contact Criteria
Inorganics (mg/kg)				
Arsenic	11.5/32.2	9.77/25.1	13	---
Manganese	889/1820	736/1600	636	1600
PAHs (µg/kg)				
Benzo(a)anthracene	444/1700	17/20	1800(1)	900
Benzo(a)pyrene	314/1200	14.5/22	2100(1)	90
Benzo(b)fluoranthene	429/1700	16/18	2100(1)	900
Chrysene	372/1900	10.6/18	2700(1)	88000
Dibenzo(a,h)anthracene	68.3/160	N/A	420(1)	90

(1) Applies to surface soil only
mg/kg – milligram per kilogram
µg/kg – microgram per kilogram

Summary of Noncarcinogenic Risks

Pathway-specific Reasonable Maximum Exposure (RME) and Central Tendency Exposure (CTE) HIs were less than or equal to 1.0 for trespassers, maintenance workers, occupational workers, and future adult residents in the study area. For this reason, adverse noncarcinogenic health effects are not anticipated for these receptors at Site 19.

As per the Work Plan, the HIs were calculated using the USEPA Particulate Emissions Factor (PEF). For the construction worker pathway, this resulted in a total RME HI of 10 and a total CTE HI of 5, due to inhalation exposure to manganese in soil. However, it was collectively determined by the Navy, Illinois EPA, and Tetra Tech that the USEPA PEF was overly conservative for this site and not a realistic representation of Site 19. Therefore, a site-specific determination, based on the size and location of Site 19, was made to use the Illinois EPA TACO PEF to calculate the HIs for the inhalation construction worker pathway. The Illinois EPA TACO PEF is less conservative than the USEPA PEF; however, it is still considered conservative and protective by the regulatory agency.

This recalculation resulted in a construction worker total RME HI of 1 and a total CTE HI of 0.5, which are less than or equal to 1.0. Therefore, adverse noncarcinogenic health effects are not anticipated for the construction worker receptor at Site 19. These calculations and risk summaries of the construction worker pathway are presented in Appendix B and a summary in presented below in Table 1-2.

TABLE 1-2

SITE 19 SUMMARY OF CONSTRUCTION WORKER HI CALCULATIONS

	Total RME HI for Construction Worker Pathway	Total CTE HI for Construction Worker Pathway
Previous HI using USEPA PEF	5	4
New HI using Illinois EPA TACO PEF	1	0.5

The RME HIs were greater than 1.0 for future child residents in the study area. The CTE HIs are less than or equal to 1.0 for future child residents and construction worker receptors.

For future child residents, ingestion of soil and groundwater is the primary pathway of concern in the RME scenario. Further examination of these results reveals that the organ-specific HIs for skin and cardiovascular system, and individual Hazard Quotients (HQs) for arsenic, were the risk drivers.

The exceedances of 1.0 by organ-specific HIs and individual contaminants indicate that adverse noncarcinogenic health effects are possible under the conditions established in the exposure assessment for future child residents.

Summary of Carcinogenic Risks

RME and CTE cancer risk estimates for construction workers, maintenance workers, occupational workers, trespassers, future child residents, and future adults residents and the CTE cancer risk estimate for total future residential risk (child + adult) for Site 19 do not exceed the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). However, RME and CTE cancer risk estimates for future child residents and future adult residents and the CTE cancer risk estimate for total future residents (child + adult) exceed the Illinois EPA risk goal ($1x10^{-6}$).

The total (soil + groundwater) site RME cancer risk estimates for total future residents (adult + child), exceed the USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$) and Illinois EPA risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 19 are arsenic and PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and dibenzo(a,h)anthracene).

While independent of the development of the Site 19 Human Health Baseline Risk Assessment, it is interesting to note that, from a regulatory perspective, PAHs in site soil do not exceed allowable

concentrations under the Illinois EPA TACO Tier 1 Objectives. Concentrations of PAHs were higher in surface soil than subsurface and maximum concentrations of PAHs that were found to exceed Tier 1 risk-based objectives were below background concentrations identified under TACO for counties within the Metropolitan Statistical Area.

The levels of contamination found in the soil at Site 19 are acceptable for commercial/industrial use and are safe for worker exposure. Under the current land use within Naval Station Great Lakes, no action would be necessary to protect those who work at or near the property. However, because levels of contamination in soil do not currently meet Illinois' standards for residential properties, the Navy is considering remedial alternatives to address this hypothetical future risk.

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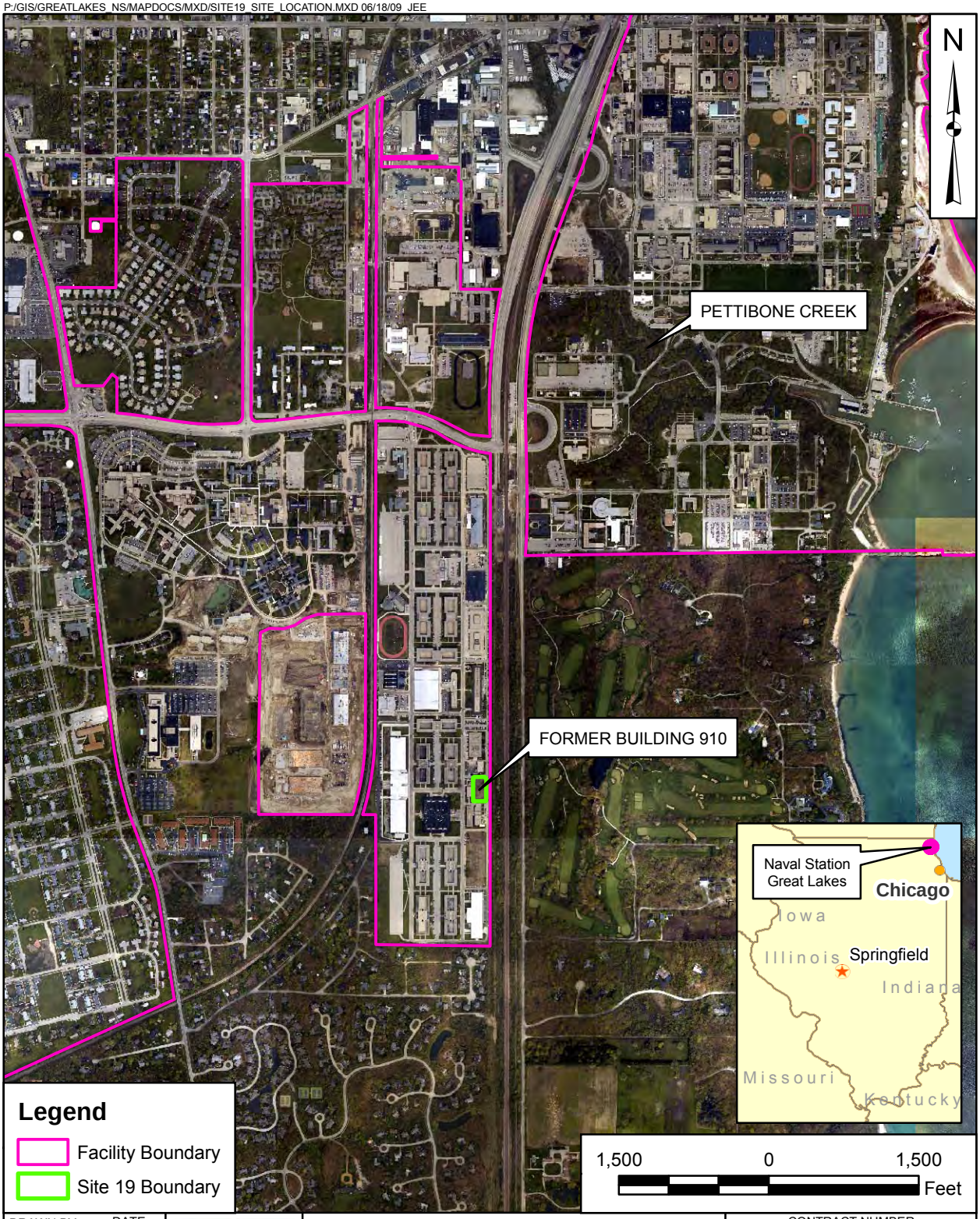

DRAWN BY K. MOORE	DATE 06/18/09	LOCATION MAP SITE 19 - FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER CTO 0468
CHECKED BY RFD	DATE 03/23/12		APPROVED BY RFD — DATE 06/19/09
REVISED BY AS NOTED	DATE		APPROVED BY — DATE —
SCALE			FIGURE NO. FIGURE 1-1 — REV 0

NAVFAC

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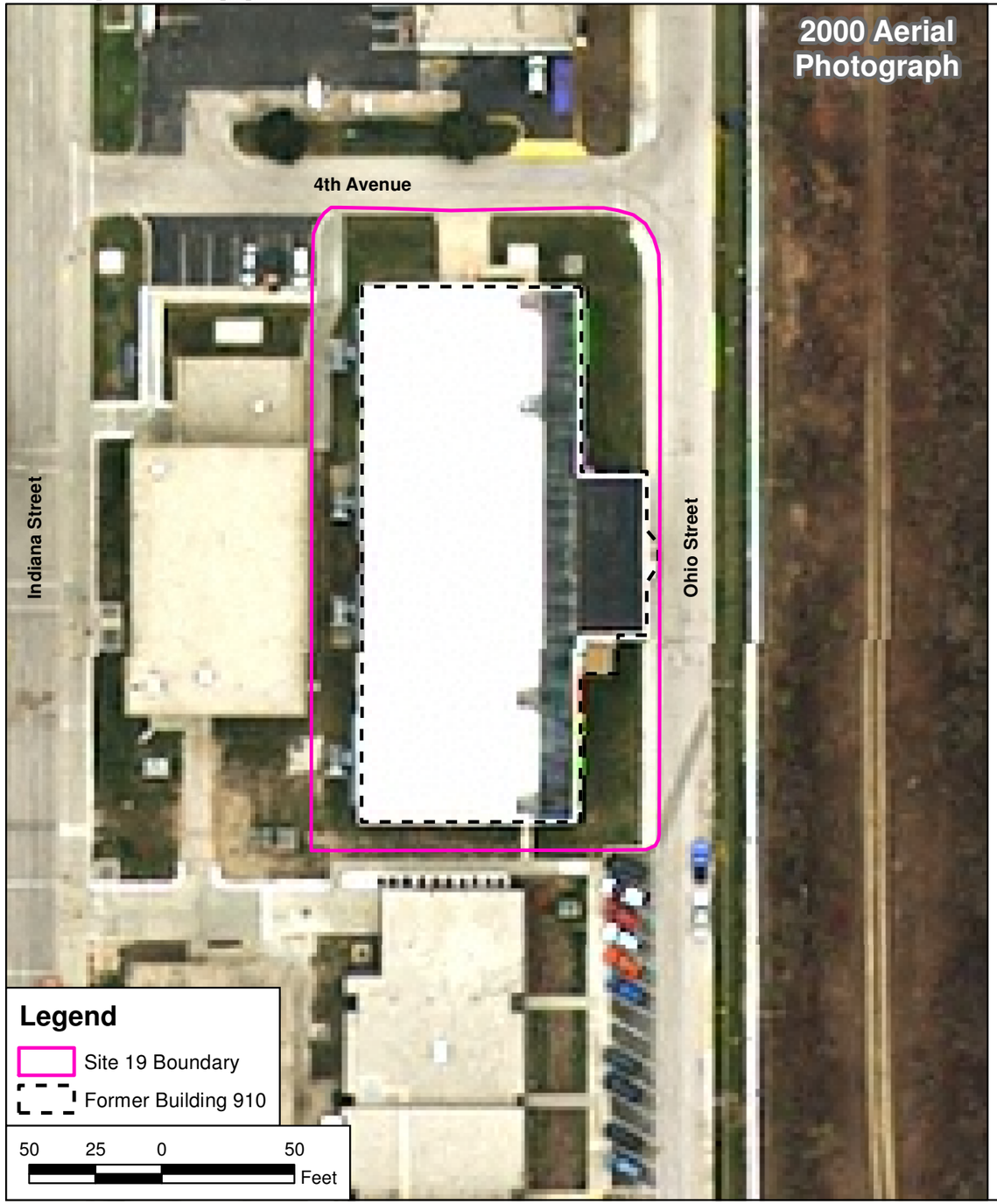

2000 Aerial Photograph

2008 Aerial Photograph

N

Legend

- Site 19 Boundary
- Former Building 910

50 25 0 50 Feet

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K. MOORE	08/15/07
CHECKED BY	DATE
C. GALAND	05/09/12
REVISED BY	DATE
S. PAXTON	05/09/12
SCALE	
AS NOTED	

NAVFAC

SITE MAP
SITE 19 - FORMER BUILDING 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	
CTO 0468	
APPROVED BY	DATE
RFD	06/19/09
APPROVED BY	DATE
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FIGURE NO.	REV
FIGURE 1-2	0

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DRAWN BY S. PAXTON	DATE 05/09/12		SITE PHOTOGRAPH SITE 19 - FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER CTO 0468
CHECKED BY C. GALAND	DATE 05/09/12			APPROVED BY RFD / DATE 06/19/09
REVISED BY —	DATE —			APPROVED BY — / DATE —
SCALE AS NOTED		NAVFAC		FIGURE NO. FIGURE 1-3 / REV 0

2.0 REMEDIAL ACTION OBJECTIVE AND GENERAL RESPONSE ACTIONS

This section presents the Remedial Action Objective (RAO) for the site. The objectives and goals for the remedial action at the site provide the basis for selecting RAOs and identifying remedy technologies to address unacceptable exposure scenarios that may be encountered. This section also presents General Response Actions (GRAs) for contaminated media at the site. GRAs are categories of actions that could be implemented to satisfy or address a component of the RAOs for the site. Lastly, this section provides an estimate of the area and volume of contaminated media to be addressed at the site.

2.1 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals that define the objectives of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable ranges of contaminant concentrations [i.e., preliminary remediation goals (PRGs)] for the site. Section 2.1.1 presents the RAO developed for the Site.

The development of PRGs takes into consideration Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) criteria. Section 2.1.2 identifies the ARARs and TBCs.

2.1.1 Statement of Remedial Action Objectives

Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. The RAOs for this FFS were developed based on the current land use as industrial/commercial property and future potential land use as residential property, with the goals of protecting the public from potential current and future health risks.

The following RAO was developed for Site 19:

RAO 1: Prevent unacceptable human health risk to hypothetical future residents associated with exposure to soil containing arsenic at concentrations greater than background levels.

2.1.2 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

Applicable requirements are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility

siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

If a requirement is not applicable, it still may be relevant and appropriate. Relevant and appropriate requirements are those cleanup standards that address problems or situations sufficiently similar to those encountered at the CERCLA site. A requirement that is relevant and appropriate may not meet one or more jurisdictional prerequisites for applicability but still make sense at the site, given the circumstances of the site and the release.

When a requirement is deemed relevant and appropriate, it must be complied with as if it were applicable. However, there are significant differences between the identification and analysis of the two types of requirements. Applicability is a legal and jurisdictional determination, while the determination of relevant and appropriate relies on professional judgment, considering environmental and technical factors at the site. Also, there is more flexibility when determining relevant and appropriate. A requirement may be relevant in that it covers situations similar to those at the site, but may not be appropriate; therefore, may not be well suited to the site. In some situations, only portions of a requirement or regulation may be judged relevant and appropriate; however, if a requirement is applicable, all substantive parts must be followed.

2.1.2.1 Chemical-Specific ARARs and TBCs

Federal and state chemical-specific ARARs and TBCs are listed in Table 2-1.

The Illinois EPA TACO Tier 1 Soil Remediation Objectives were retained as TBCs. The Tier 1 TACO for residential and industrial/commercial properties does not regulate activities at a site or mandate fixed cleanup standards, rather, TACO provides methodologies for meeting the requirements of programs to which it is applied [Illinois Pollution Control Board No. R97-12 (A), p.1 (Illinois EPA, 2007)]. The applicability section of TACO provides that a person "may elect to proceed under this Part" (35 IAC 742.105(a). This language is permissive, not a requirement. Therefore, TACO is not enforceable by its own terms, but relies upon the language of the governing program for its enforceability. Because TACO is not enforceable unto itself, TACO cannot be an ARAR as defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and must be treated as TBC guidance.

2.1.2.2 Location-Specific ARARs and TBCs

Federal and state location-specific ARARs and TBCs are listed in Table 2-2.

The Illinois Coastal Management Program (ICMP) was retained as a location-specific TBC. In January 2012, National Oceanic and Atmospheric Administration approved the ICMP, which was prepared according to the federal Coastal Zone Management Act.

The ICMP identifies a framework of existing programs, laws, and policies that bring state agencies into a comprehensive network. The ICMP does not provide any additional rules or regulations. The CERCLA process, which identifies ARARs and TBCs through input from both USEPA and state agencies, will identify the enforceable policies that would be identified using the ICMP process. Because the ICMP process would be duplicative, administrative, and provide no additional substantive requirements, the ICMP could be excluded from the ARAR/TBC list.

2.1.2.3 Action-Specific ARARs

Action-specific ARARs and TBCs are those regulations, criteria, and guidance that must be complied with or taken into consideration during on-site implementation of GRAs. Action-specific ARARs and TBC criteria are technology- or activity-based controls or restrictions on activities related to management of hazardous substances. Action-specific ARARs pertain to implementing a given remedy. Action-specific ARARs and TBCs are listed along with appropriate actions in Table 2-3.

2.2 GENERAL RESPONSE ACTIONS

GRAs are broadly defined remedial approaches that may be used (by themselves or in combination with others) to attain the RAOs. Because the Human Health Risk Assessment identified potential noncarcinogenic risks at a concentration in excess of the HI of 1 and carcinogenic risks in excess of 1×10^{-4}, Naval Facilities Engineering Command (NAVFAC) has developed the following GRAs for Site 19:

- No Action – no direct action to be conducted to remediate the site.
- Limited Action [i.e. Land Use Controls (LUCs)].
- Excavation and Disposal of Contaminated Soil.

The most conservative of the Illinois EPA TACO Tier 1 Remediation Objectives for residential, industrial/commercial, and construction worker exposure via incidental ingestion and inhalation were used to identify target concentrations for consideration of unrestricted use of the property. Target concentrations of PAHs and inorganics also took background concentrations, as defined in the TACO Appendix A Table G for Inorganics and Appendix A Table H for PAHs, into consideration.

2.3 ESTIMATED VOLUMES OF CONTAMINATED SOIL

Based on the evaluation of contaminant concentrations in Site 19 soil, it was concluded that concentrations of PAHs are acceptable based on a comparison with the most conservative TACO Tier 1 criteria and the TACO Appendix A Table H background values identified for surface soil. Therefore, no remedial actions are proposed to address PAHs in Site 19 soil.

Under CERCLA, once a potentially unacceptable risk has been demonstrated, chemical-specific ARARs can be applied to a site. While the TACO Tier 1 Remedial Objectives are considered TBCs, NAVFAC has elected to use the most conservative of the residential, industrial/commercial, and construction worker criteria to identify a baseline that would be acceptable for unrestricted use of the property. Based on maximum detections observed in both surface and subsurface soil, contaminant concentrations exceed residential criteria for incidental ingestion for arsenic.

For remedial action purposes, the volume of inorganic contaminated soil at Site 19 was estimated based on the locations of samples where arsenic concentrations exceeded 13 mg/kg (background).

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 1 OF 3

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
Cancer Slope Factors (CSFs)	-	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Risks due to carcinogens as assessed with slope factors will be addressed excavation and off-site disposal and/or land use controls (LUCs).
Reference Doses (RfDs)	-	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. Hazards due to noncarcinogens with EPA RfDs will be addressed excavation and off-site disposal and/or LUCs.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Hazards due to carcinogens assessed through this guidance will be addressed excavation and off-site disposal and/or LUCs.

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
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Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (continued)				
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Carcinogenic risks to children assessed through this guidance will be addressed excavation and off-site disposal and/or LUCs.
Regional Screening Levels for Chemical Contaminants at Superfund Sites for Residential and Industrial receptors	USEPA Oak Ridge National Laboratory (2008)	To Be Considered	Chemical contaminant screening level guidance.	RSLs are used when a potential site is initially investigated to determine if potentially significant levels of contamination are present to warrant further investigation. Screening levels may be used during the initial scoping of remediation goals, but remediation goals are ultimately selected based on site-specific information. The RSL tables were not generated to represent action levels or cleanup levels.

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 3 OF 3

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State				
Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) - Tier 1 Soil Remediation Objectives	35 IAC 742.505 (a)(1) and (a)(2) - (Tier 1 Soil Remediation Objectives); 742.1012 - (Institutional Controls, Federally Owned Property); Section 742.Table G and Table H – Background Soil Concentrations	To Be Considered	This part sets forth procedures for evaluating the risk to human health posed by environmental conditions and developing remediation objectives that achieve acceptable risk levels, and to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information. A Tier 1 evaluation compares the concentration of contaminants detected at a site to the corresponding tabulated remediation objectives for residential and industrial/commercial properties.	These values were used to develop Preliminary Remediation Goals (PRGs). Facility is in Metropolitan area where background values apply.

TABLE 2-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

REQUIREMENT	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
There are no federal location-specific ARARs.				
State				
Coastal Zone Management	Illinois Coastal Management Program (ICMP) – Chapter 11, Federal Consistency and the National Interest	To Be Considered	On January 31, 2012, the ICMP received federal approval under the Coastal Zone Management Act (CZMA). The ICMP will work to preserve, protect, restore, and where possible, enhance coastal resources. The ICMP document identifies a framework of existing programs, laws, and policies that brings state agencies into a comprehensive network. The coastal zone is defined in the ICMP.	Per the CZMA, the ICMP excludes lands that are owned by the federal government. The exclusion of federally owned does not exempt activities occurring on those lands from CZMA federal consistency requirements. As federally owned land, Naval Station Great Lakes is excluded from the CZMA.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
There are no federal action-specific ARARs.				
State				
Identification and Listing of Hazardous Waste	35 IAC 721 Subparts C and D	Applicable	Identifies those solid wastes that are subject to regulation as hazardous wastes.	These regulations would apply when determining whether or not a solid waste, such as contaminated soil is hazardous, either by being listed or exhibiting a hazardous characteristic.
Standards Applicable to Generators of Hazardous Waste	35 IAC 722.111 and 722 Subpart C	Applicable	Characterization of waste is required to determine if it is a hazardous waste. Subpart C Establishes manifesting, pre-transport, and accumulation requirements for hazardous waste.	If contaminated soil is determined to be hazardous, these regulations would apply.
Fugitive Particulate Dust	35 IAC 212 Subpart K	Applicable	No person shall cause or allow the emission of fugitive particulate matter from any process, including any material handling or storage activity that is visible by an observer looking generally toward the zenith at a point beyond the property line of the source.	Control of dust during excavation and handling of soil would be implemented to prevent material from becoming airborne.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (continued)				
Illinois Urban Manual (2010)	None	To be considered	The standards and associated materials describe best management practices for controlling non-point source pollution impacts that affect ecosystems in existing communities and developing areas. The manual includes BMPs for soil erosion and sediment control; stormwater management; and special area protection.	Soil excavation activities would need to meet these requirements.
Illinois Solid Waste and Special Waste Hauling	35 IAC 809	Potentially Applicable	These regulations would apply if waste is transported to a disposal facility.	This regulation would apply if excavation and hauling was performed.

3.0 SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential remediation technologies and process options that may be applicable to Site 19 at Naval Station Great Lakes. The primary objective of this phase of the FFS is to develop an appropriate range of remediation technologies and process options that will be used for developing remedial alternatives.

3.1 PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The preliminary screening of remediation technologies and process options is based on overall applicability to the medium of concern, COCs, and specific conditions present at the Site. Table 3-1 summarizes the preliminary screening of remediation technologies and process options for both GRAs.

TABLE 3-1
REMEDIATION TECHNOLOGIES

GRA	Remediation Technology	Process Option
No Action	None	Not applicable
Limited Action	Institutional Controls	LUCs
Removal	Excavation/Disposal	Off-base landfill disposal

3.2 DETAILED SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

3.2.1 No Action

No Action would consist of “walking away” from the site without implementing any remedial action or performing any monitoring and/or maintenance. As required under CERCLA regulations, the No Action alternative is carried through the FFS to provide a baseline for comparison to other alternatives and their effectiveness in mitigating risks posed by site COCs.

3.2.1.1 Effectiveness

The No Action alternative would not be effective in reducing risks or meeting the RAO and PRGs because no exposure control or treatment would be performed. Because no monitoring or maintenance would be performed, the No Action alternative would not be effective in evaluating the potential migration of COCs, or the potential reduction of COC concentrations.

3.2.1.2 Implementability

There would be no implementability concerns because no actions would be implemented.

3.2.1.3 Cost

There would be no costs associated with the No Action alternative.

3.2.1.4 Conclusion

Although it would not be effective, the No Action alternative will be retained for comparison to other options.

3.2.2 LUCs

Based on other LUCs implemented at Naval Station Great Lakes and site conditions, the LUCs would include only property use restrictions. While the contaminants in soil at Site 19 are at concentrations that are acceptable for commercial/industrial use, the concentrations do not meet Illinois' more restrictive standards for residential properties. Therefore, the area in question may be restricted to industrial/commercial (nonsensitive) use.

The Illinois EPA and the Navy have signed a LUC Memorandum of Agreement (MOA) that includes a Naval Station Policy Letter restricting use of groundwater on the Naval Station Great Lakes property. Because there are no identified exceedances of risk-based standards in groundwater, no additional groundwater use restrictions would be included in this action to address groundwater below Site 19.

3.2.2.1 Effectiveness

LUCs alone would not effectively reduce concentrations of COCs. However, LUCs would be an effective tool to prevent future exposure to the COCs.

3.2.2.2 Implementability

LUCs have been implemented throughout Naval Station Great Lakes and could be readily implemented at this site.

3.2.2.3 Cost

Costs to implement and maintain the LUCs would be low. A detailed cost estimate is provided in Appendix A.

3.2.2.4 Conclusion

LUCs are retained for the development of remedial alternatives.

3.2.3 Removal

The only technology considered for removal is mechanical excavation. Mechanical excavation of the impacted soil would be performed using excavators. After excavation is completed, the location would be filled and graded with clean fill material. Excavated materials would be transported offsite for disposal in a non-hazardous landfill.

3.2.3.1 Effectiveness

Mechanical excavation would not reduce concentrations of COCs in the impacted soil, but would be an effective means for addressing soil with COC concentrations greater than PRGs from the site in order to open the property to unrestricted use.

3.2.3.2 Implementability

Mechanical excavation of soil would be implementable, and the necessary resources, equipment, and materials would be readily available. It is anticipated that, based on results from the RI, excavated material could be disposed in a non-hazardous waste landfill.

3.2.3.3 Cost

The cost of mechanical excavation would be moderate and is estimated to be approximately $385,000 for inorganic contaminated soil removal. A detailed cost estimate is provided in Appendix A.

3.2.3.4 Conclusion

Mechanical excavation is retained for the development of remedial alternatives.

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 INTRODUCTION

In this section, the remediation technologies retained from the components selected in Section 3.0 are assembled into remediation alternatives. This section presents an evaluation of each remedial alternative with respect to the criteria of the NCP of 40 Code of Federal Regulations (CFR) Part 300, as revised in 1990. The criteria required by the NCP and the relative importance of these criteria are described in the following subsections.

4.1.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

4.1.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two (state and community acceptance) are considered to be modifying criteria that must be considered during remedy selection. The last criterion, community acceptance, cannot be completely evaluated until comments on the Proposed Plan are received from the public.

4.1.3 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan to the community for review and comment.

The second step consists of the Navy's review of the public comments and a determination of whether or not the preferred alternative continues to be the most appropriate remedial action for the site, in consultation with Illinois EPA.

4.2 ASSEMBLY OF REMEDIAL ALTERNATIVES

This section develops the remedial alternatives for the Site. Additional site-specific information and assumptions are provided in this section to further explain the alternative development process.

Based on the technology screening presented in Section 3.0, the following three remedial alternatives were developed for the Site:

- Alternative 1: No Action
- Alternative 2: LUCs
- Alternative 3: Excavation and Off-Site Disposal

Alternative 1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative 2 was developed and analyzed to evaluate restricting usage of the

site, while Alternative 3 was formulated and analyzed to evaluate a removal remedy and its components. A description and detailed analysis of these alternatives is presented in the following sections.

4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.3.1 Alternative 1: No Action

4.3.1.1 Description

This alternative is a "walk-away" alternative required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use. In addition, there would be no Five-Year Review required to assess contamination at the site over time. This alternative could only be chosen if it is determined that taking no action would be protective of human health and the environment.

4.3.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 1 would not provide protection of human health and the environment. The potential for exposure of human receptors to contaminated soil via incidental ingestion and inhalation would remain unchanged.

Compliance with ARARs and TBCs

Alternative 1 would not comply with chemical- or location-specific ARARs and TBCs because no action would be taken to reduce COC concentrations. No action-specific ARARs are associated with this alternative.

Long-Term Effectiveness and Permanence

Alternative 1 would have no long-term effectiveness or permanence because nothing would be done to reduce concentrations of soil COCs or to reduce human exposure to site contaminants

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative 1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment.

Alternative 1 would not achieve the RAOs or the PRGs and would also have no life cycle sustainability impacts.

Implementability

Because no action would occur, Alternative 1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The remedy would be implementable if ultimately selected in the Record of Decision.

Cost

There would be no costs associated with Alternative 1.

State Acceptance

Since contaminants remain on site at concentrations above background and TACO screening criteria, Alternative 1 is not an acceptable alternative.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

4.3.2 Alternative 2: LUCs

4.3.2.1 Description

LUCs would be established at the site to make sure the property is not developed for residential use or for non-residential special use (such as for a park, day care, or school) by a population that would require special protections. Additionally, LUCs would require review of construction activities and intrusive work in the area to protect workers and confirm proper management of contaminated materials. Five-Year Reviews would be required since concentrations of contaminants will remain in soil above levels acceptable for unrestricted use at the site.

4.3.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 2 would provide protection to human health by minimizing exposure to contaminated soil but would not provide protection to the environment.

Compliance with ARARs and TBCs

Although no action would be taken to reduce COC concentrations, Alternative 2 would comply with location- and chemical-specific ARARs and TBCs by restricting access to the site and controlling exposure to contaminant concentrations in excess of those acceptable for residential use. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the controls that would be placed on the property. No action-specific ARARs are associated with this alternative.

Long-Term Effectiveness and Permanence

Alternative 2 would be an effective means of minimizing exposure to contaminants in site soil over the long term. The permanence of Alternative 2 would depend on the maintenance of the controls and verification that the land use is being properly controlled.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 2 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative 2 would not achieve the PRGs, but would achieve the RAO by restricting exposure to soil at the site. Life cycle sustainability impacts of this alternative are energy consumption and greenhouse gas (CO_2) emissions associated with travel to the site for annual inspections.

Implementability

Alternative 2 would be easily implemented since LUCs are already in place at Naval Station Great Lakes.

Cost

The estimated costs for Alternative 2 are shown below and a detailed cost estimate is provided in Appendix A. These costs have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates:

- Capital Cost: $23,000
- Annual Cost: $2,000
- 5 Year Cost: $25,000
- 30-Year Net Present Worth (NPW): $190,000

State Acceptance

The Illinois EPA has indicated that Alternative 2 could be an acceptable alternative because LUCs are frequently used to manage properties impacted by low-level soil contamination where concentrations exceed residential criteria but are otherwise acceptable for commercial/industrial development.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

4.3.3 Alternative 3: Excavation and Off-Site Disposal

4.3.3.1 Description

Alternative 3 would consist of soil excavation at the area shown on Figure 4-1, as necessary, to meet the TACO Tier 1 Remedial Objectives for arsenic and manganese. The excavated area abuts the neighboring building to the west and it is assumed that the contaminated soil is not under the building. Excavated material would be transported off-base to a non-hazardous landfill for disposal. No Five-Year Review would be required for this alternative since the contaminated soil would be removed from the site. After completion of remedial action, the property could be developed with no restrictions on land use.

4.3.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment, as contaminants would be permanently removed from the site.

Compliance with ARARs and TBCs

Alternative 3 would comply with chemical- and location-specific ARARs and TBCs. Alternative 3 would also comply with all action-specific ARARs relevant to the excavation, transportation, and off-site disposal of contaminated soil.

Long-Term Effectiveness and Permanence

Alternative 3 would provide long-term effectiveness and permanence. Although no treatment would be used to reduce COC concentrations, the contaminated soil would be removed from the site, thereby limiting exposure to human receptors.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 contains no treatment component; therefore, no reduction in contaminant toxicity, mobility, or volume would be realized through treatment.

Short-Term Effectiveness

Implementation of Alternative 3 could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-base landfill disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate personal protective equipment. Appropriate site monitoring would also be implemented for this alternative to measure emissions from the excavation activities.

Life cycle impacts associated with mechanical excavation include greenhouse gas emissions, criteria pollutant emissions, water consumption, and energy consumption. This alternative can be optimized to

reduce greenhouse gas and criteria pollutant emissions by using biodiesel fuel instead of petroleum based diesel.

Implementability

Alternative 3 would be easily implemented. The area of excavation is developed and there are utilities and utility corridors around and through the site. Implementation of Alternative 3 would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. While constituting a significant effort, these procedures could readily be accomplished.

Cost

The estimated capital cost for removal of inorganic contaminated soil is $385,000. A detailed cost estimate is provided in Appendix A. These costs are rounded to the nearest $1,000 to reflect the preliminary nature of the estimates.

State Acceptance

The state has indicated that soil excavation to meet TACO Tier 1 Remediation Objectives for inorganics would be acceptable.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

4.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 4-1 compares the analyses of the remedial alternatives that were described above. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives. The Navy has the option of selecting any alternative or combination of alternatives.

TABLE 4-1

**NINE EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS**

Threshold Criteria

1	Overall Protection of Human Health and the Environment	Will it protect you and the plant and animal life on and near the site? EPA and the Navy will not choose a plan that does not meet this basic criterion.
2	Compliance with ARARs	Does the alternative meet all federal environmental, state environmental, and facility siting statues, regulations and requirements? The chosen cleanup plan must meet this criterion.

Primary Balancing Criteria

3	Long-Term Effectiveness and Permanence	Will the effects of the cleanup plan last or could contamination cause future risk?
4	Reduction of Toxicity, Mobility or Volume through Treatment	Using treatment, does the alternative reduce the harmful effects of the contaminants, the spread of contaminants, and the amount of contaminated material?
5	Short-Term Effectiveness	How soon will site risks be adequately reduced? Could the cleanup cause short-term hazards to workers, residents, or the environment?
6	Implementability	Is the alternative technically feasible? Are the right goods and services available for the plan?
7	Cost	What is the total cost of an alternative over time? EPA and the Navy must find a plan that gives necessary protection for a reasonable cost

Modifying Criteria

8	State Acceptance	Does the state agree with the proposal?
9	Community Acceptance	What objections, suggestions, or modifications do the public offer during the comment period?

TABLE 4-2

**SUMMARY OF COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS**

EVALUATION CRITERION	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LUCs	ALTERNATIVE 3: EXCAVATION AND OFF-BASE DISPOSAL
Overall Protection of Human Health and Environment	Not protective. The potential for exposure of human receptors to contaminated soil would remain unchanged.	Protective of human health by minimizing exposure to contaminated soil.	Protective of human health as contaminants would be permanently removed from the site.
Compliance with ARARs & TBCs: Chemical-Specific Location-Specific Action-Specific	 *Would not comply *Not applicable *Not applicable	 *Would comply via control of exposure pathways. *Would comply *Not Applicable	 *Would comply *Would comply *Would comply
Long-Term Effectiveness and Permanence	Neither effective nor permanent.	Provides long-term effectiveness and permanence.	Provides long-term effectiveness and permanence.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None.	None.	None.
Short-Term Effectiveness	Would not result in risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would not achieve RAO or PRGs.	Would not result in risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would achieve RAO and PRGs via control of exposure pathways.	Would not result in risks to on-site workers or result in short-term adverse impacts to local community and the environment. Would achieve RAO and PRGs by removal of the contaminated soil. Life cycle impacts resulting from excavation activities include greenhouse gas and criteria pollutant emissions, water and energy consumption. This alternative can be optimized to reduce greenhouse gas and criteria pollutant emissions by using biodiesel.
Implementability	Readily implementable.	Readily implementable.	Readily implementable.
Costs:	$0	Capital Cost: $23,000 Annual Cost $3,000 5 Year Cost: $25,000 30-Year NPW: $190,000	$385,000
State Acceptance	Illinois EPA has indicated that Alternatives 2 or 3 would be acceptable alternatives.		
Community Acceptance	Assessment will be performed after comments on the Proposed Plan are received from the public.		

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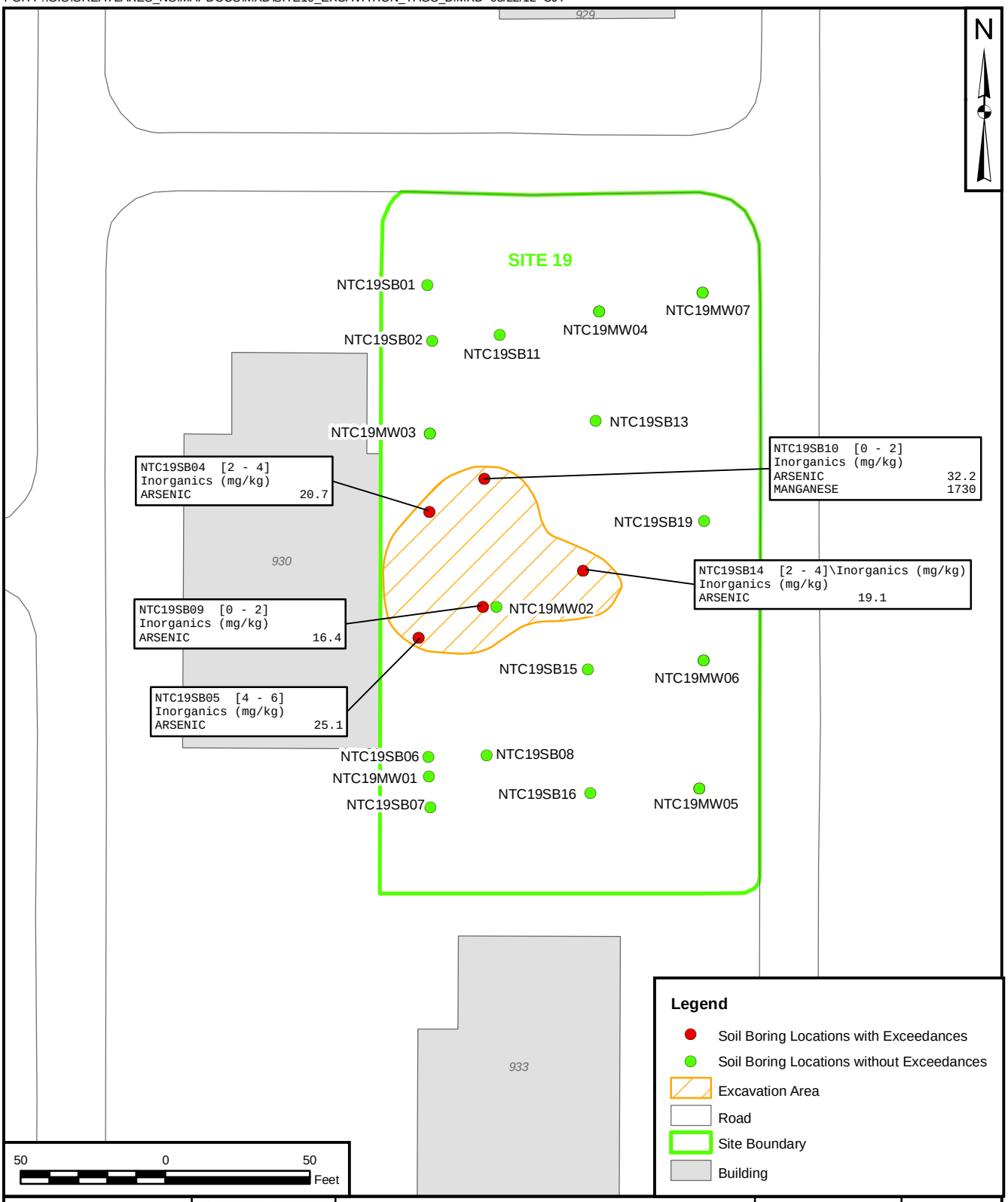

DRAWN BY	DATE
S. PAXTON	05/11/12
CHECKED BY	DATE
C. GALAND	05/11/12
REVISED BY	DATE
C. TULLEY	05/22/12
SCALE	
AS NOTED	

NAVFAC

APPROXIMATE LIMITS OF EXCAVATION
SITE 19 - FORMER BUILDING 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
0936	468
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO.	REV
FIGURE 4 - 1	0

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APPENDIX A

COST ESTIMATE

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910
Alternative 2: LUCs with 5-Year Reviews
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910
Alternative 2: LUCs with 5-Year Reviews
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$23,423		$23,423	1.000	$23,423
1		$2,585	$2,585	0.980	$2,534
2		$2,585	$2,585	0.961	$2,485
3		$2,585	$2,585	0.942	$2,436
4		$2,585	$2,585	0.924	$2,388
5		$27,885	$27,885	0.906	$25,256
6		$2,585	$2,585	0.888	$2,295
7		$2,585	$2,585	0.871	$2,250
8		$2,585	$2,585	0.853	$2,206
9		$2,585	$2,585	0.837	$2,163
10		$27,885	$27,885	0.820	$22,875
11		$2,585	$2,585	0.804	$2,079
12		$2,585	$2,585	0.788	$2,038
13		$2,585	$2,585	0.773	$1,998
14		$2,585	$2,585	0.758	$1,959
15		$27,885	$27,885	0.743	$20,719
16		$2,585	$2,585	0.728	$1,883
17		$2,585	$2,585	0.714	$1,846
18		$2,585	$2,585	0.700	$1,810
19		$2,585	$2,585	0.686	$1,774
20		$27,885	$27,885	0.673	$18,766
21		$2,585	$2,585	0.660	$1,706
22		$2,585	$2,585	0.647	$1,672
23		$2,585	$2,585	0.634	$1,639
24		$2,585	$2,585	0.622	$1,607
25		$27,885	$27,885	0.610	$16,997
26		$2,585	$2,585	0.598	$1,545
27		$2,585	$2,585	0.586	$1,514
28		$2,585	$2,585	0.574	$1,485
29		$2,585	$2,585	0.563	$1,456
30		$27,885	$27,885	0.552	$15,394
			TOTAL PRESENT WORTH		**$190,201**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910
Alternative 2: LUCs with 5-Year Reviews
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare LUC Documents	300	hr			$39.00		$0	$0	$11,700	$0	$11,700
Subtotal							$0	$0	$11,700	$0	$11,700
Overhead on Labor Cost @ 30%									$3,510		$3,510
G & A Cost @ 10%							$0	$0	$1,170	$0	$1,170
Tax on Materials and Equipment Cost @ 6.25%								$0		$0	$0
Total Direct Cost							$0	$0	$16,380	$0	$16,380
Indirects on Total Direct Cost @ 20%											$3,276
Profit on Total Direct Cost @ 10%											$1,638
Subtotal											$21,294
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$21,294
Contingency on Total Field Costs @ 10%											$2,129
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$23,423**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910
Alternative 3: Excavation and Off-Site Disposal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	250	hr			$39.00		$0	$0	$9,750	$0	$9,750
1.2 Prepare Permits	200	hr			$39.00		$0	$0	$7,800	$0	$7,800
1.3 Prepare Shoring Design	150	hr			$39.00		$0	$0	$5,850	$0	$5,850
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	4	ea			$188.00	$566.00	$0	$0	$752	$2,264	$3,016
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	1	mo				$94.00	$0	$0	$0	$94	$94
3.2 Survey Support	1	day	$1,150.00				$1,150	$0	$0	$0	$1,150
3.3 Site Superintendent	12	day		$242.00	$384.24		$0	$2,904	$4,611	$0	$7,515
3.4 Underground Utility Clearance	1	ls	$7,350.00				$7,350	$0	$0	$0	$7,350
4 DECONTAMINATION											
4.1 Decontamination Services	0.5	mo		$1,220.00	$2,245.00	$1,550.00	$0	$610	$1,123	$775	$2,508
4.2 Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3 Decon Water	500	gal		$0.20			$0	$100	$0	$0	$100
4.4 Decon Water Storage Tank, 6,000 gallon	0.5	mo				$813.00	$0	$0	$0	$407	$407
4.5 Clean Water Storage Tank, 4,000 gallon	0.5	mo				$731.00	$0	$0	$0	$366	$366
4.6 Disposal of Decon Waste (liquid & solid)	0.5	mo	$985.00				$493	$0	$0	$0	$493
5 EXCAVATION, DISPOSAL, AND RESTORATION											
5.1 Foundation Shoring	200	sf	$9.30				$1,860	$0	$0	$0	$1,860
5.2 Excavator, 2.5 cy	8	day			$372.40	$1,652.00	$0	$0	$2,979	$13,216	$16,195
5.3 Dozer, 140 hp	8	day			$358.00	$817.40	$0	$0	$2,864	$6,539	$9,403
5.4 Site Labor, (3 laborers)	24	day			$280.80		$0	$0	$6,739	$0	$6,739
5.5 Transport & Dispose Excavated Soil, nonhazardous	795	ton	$85.00				$67,575	$0	$0	$0	$67,575
5.6 Waste Disposal Characterization / Analytical	1	ea	$850.00	$30.00	$50.00	$30.00	$850	$30	$50	$30	$960
5.7 Backfill, common fill	265	cy		$24.65			$0	$6,532	$0	$0	$6,532
5.8 Backfill, gravel	265	cy		$31.50			$0	$8,348	$0	$0	$8,348
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	150	hr			$39.00		$0	$0	$5,850	$0	$5,850
6.2 Remedial Action Closeout Report	200	hr			$39.00		$0	$0	$7,800	$0	$7,800
Subtotal							$79,278	$23,024	$59,168	$24,415	$185,884
Overhead on Labor Cost @ 30%									$17,750		$17,750
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$7,928	$2,302	$5,917	$2,442	$18,588
Tax on Materials and Equipment Cost @ 6.25%								$1,439		$1,526	$2,965
Total Direct Cost							$87,205	$26,765	$82,835	$28,383	$225,188
Indirects on Total Direct Cost @ 25% (excluding transportation and disposal cost)											$39,280
Profit on Total Direct Cost @ 10%											$22,519
Subtotal											$286,987

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Health & Safety Monitoring @ 3%											$8,610
Total Field Cost											$295,596
Engineering on Total Field Cost @ 10%											$29,560
Contingency on Total Field Cost @ 20%											$59,119
TOTAL CAPITAL COST											**$384,275**

APPENDIX B

CONSTRUCTION WORKER PATHWAY
CALCULATIONS AND RISK SUMMARY

TABLE 4.8

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) = $\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01
Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.8. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	2.7E-08	mg/m^3	1.5E-05	mg/m^3	1.8E-03
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	1.9E-07	mg/m^3	5.0E-04	mg/m^3	3.8E-04
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	4.3E-08	mg/m^3	1.0E-04	mg/m^3	4.3E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	2.1E-08	mg/m^3	6.0E-06	mg/m^3	3.5E-03
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	2.0E-06	mg/m^3	5.0E-05	mg/m^3	4.0E-02
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	5.6E-08	mg/m^3	9.0E-05	mg/m^3	6.2E-04
	(total)										4.7E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.05**

8.8. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	4.4E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.9E-10
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	3.1E-10	mg/m^3			
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	7.0E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	5.9E-09
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	3.5E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	3.1E-10
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	3.3E-09	mg/m^3			
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	9.2E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	2.4E-11
	(total)										6.4E-09
										Total Risk Across All Exposure Routes/Pathways	**6.4E-09**

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) = $\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:

(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations

Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01
Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

TABLE 7.8a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	1.3E-08	mg/m^3	1.5E-05	mg/m^3	9.0E-04
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	9.4E-08	mg/m^3	5.0E-04	mg/m^3	1.9E-04
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	2.1E-08	mg/m^3	1.0E-04	mg/m^3	2.1E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	1.1E-08	mg/m^3	6.0E-06	mg/m^3	1.8E-03
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	1.0E-06	mg/m^3	5.0E-05	mg/m^3	2.0E-02
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	2.8E-08	mg/m^3	9.0E-05	mg/m^3	3.1E-04
	(total)										2.4E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.02**

8.8a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	2.2E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	9.5E-11
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	1.5E-10	mg/m^3			
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	3.5E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	2.9E-09
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	1.7E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	1.6E-10
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	1.7E-09	mg/m^3		$(mg/m^3)^{-1}$	
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	4.6E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	1.2E-11
	(total)										3.2E-09
										Total Risk Across All Exposure Routes/Pathways	**3.2E-09**

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) = $\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01
Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.9. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	1.8E-05	mg/m^3	5.0E-03	mg/m^3	3.6E-03
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	2.3E-08	mg/m^3	1.5E-05	mg/m^3	1.5E-03
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	3.4E-08	mg/m^3	1.0E-04	mg/m^3	3.4E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	2.1E-08	mg/m^3	6.0E-06	mg/m^3	3.5E-03
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	1.6E-06	mg/m^3	5.0E-05	mg/m^3	3.2E-02
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	5.3E-08	mg/m^3	9.0E-05	mg/m^3	5.9E-04
	(total)										4.2E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.04**

8.9. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	3.0E-08	mg/m^3			
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	3.8E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.6E-10
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	5.5E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	4.6E-09
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	3.5E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	3.1E-10
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	2.7E-09	mg/m^3			
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	8.7E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	2.3E-11
	(total)										5.1E-09
										Total Risk Across All Exposure Routes/Pathways	**5.1E-09**

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) = $\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01
Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.9a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	9.1E-06	mg/m^3	5.0E-03	mg/m^3	1.8E-03
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	1.1E-08	mg/m^3	1.5E-05	mg/m^3	7.6E-04
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	1.7E-08	mg/m^3	1.0E-04	mg/m^3	1.7E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	1.1E-08	mg/m^3	6.0E-06	mg/m^3	1.8E-03
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	8.1E-07	mg/m^3	5.0E-05	mg/m^3	1.6E-02
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	2.7E-08	mg/m^3	9.0E-05	mg/m^3	3.0E-04
	(total)										2.1E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**2.1E-02**

8.9a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	1.5E-08	mg/m^3			
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	1.9E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	8.1E-11
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	2.8E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	2.3E-09
	COBALT	8.5E+02	mg/kg	8.9E-08	mg/m^3	R	1.7E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	1.6E-10
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	1.3E-09	mg/m^3			
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	4.4E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	1.1E-11
	(total)										2.6E-09
										Total Risk Across All Exposure Routes/Pathways	**2.6E-09**

TABLE 6-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Construction/Excavation Worker	Surface Soil	Ingestion	2.E-07	- -	- -	- -	0.5	- -
		Dermal Contact	3.E-08	- -	- -	- -	0.01	- -
		Inhalation	6.E-09	- -	- -	- -	0.05	- -
		Total	2.E-07	- -	- -	- -	0.6	- -
	Subsurface Soil	Ingestion	1.E-07	- -	- -	- -	0.4	- -
		Dermal Contact	9.E-09	- -	- -	- -	0.01	- -
		Inhalation	5.E-09	- -	- -	- -	0.04	- -
		Total	1.E-07	- -	- -	- -	0.5	- -
	Groundwater	Ingestion	NA	- -	- -	- -	NA	- -
		Dermal Contact	1.E-09	- -	- -	- -	0.001	- -
		Total	1.E-09	- -	- -	- -	0.001	- -
		Total Surface Soil	2.E-07	- -	- -	- -	0.6	- -
		Total Subsurface Soil	1.E-07	- -	- -	- -	0.5	- -
		Total Groundwater	1.E-09	- -	- -	- -	0.001	- -
		Total Across the Entire Site	**3.E-07**	- -	- -	- -	**1**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Maintenance Worker	Surface Soil	Ingestion	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.009	- -
		Total	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Total Surface Soil	1.E-05	- -	- -	- -	0.2	- -
		Total Across the Entire Site	**1.E-05**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Occupational Worker	Surface Soil	Ingestion	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.009	- -
		Total	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Total Surface Soil	1.E-05	- -	- -	- -	0.2	- -
		Total Across the Entire Site	**1.E-05**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adolescent Trespasser	Surface Soil	Ingestion	1.E-06	- -	- -	- -	0.03	- -
		Dermal Contact	6.E-07	- -	- -	- -	0.002	- -
		Total	2.E-06	- -	- -	- -	0.03	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.03	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.03**	- -

TABLE 6-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Child Resident	Surface Soil	Ingestion	7.E-05	- -	cPAHs, Arsenic	- -	2	- -
		Dermal Contact	2.E-05	- -	cPAHs	Arsenic	0.05	- -
		Total	8.E-05	- -	cPAHs, Arsenic	- -	2	- -
	Groundwater	Ingestion	5.E-05	- -	Arsenic	cPAHs	1.1	- -
		Dermal Contact	6.E-08	- -	- -	- -	0.002	- -
		Total	5.E-05	- -	Arsenic	cPAHs	1.1	- -
		Total Surface Soil	8.E-05	- -	- -	- -	2	- -
		Total Groundwater	5.E-05	- -	- -	- -	1.1	- -
		Total Across the Entire Site	**1.E-04**	- -	- -	- -	**3**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Adult Resident	Surface Soil	Ingestion	2.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.008	- -
		Total	2.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
	Groundwater	Ingestion	5.E-05	- -	Arsenic	cPAHs	0.3	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0009	- -
		Total	5.E-05	- -	Arsenic	cPAHs	0.3	- -
		Total Surface Soil	2.E-05	- -	- -	- -	0.2	- -
		Total Groundwater	5.E-05	- -	- -	- -	0.3	- -
		Total Across the Entire Site	**7.E-05**	- -	- -	- -	**0.5**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Total Residential Risks	Surface Soil	Ingestion	8.E-05	- -	cPAHs, Arsenic	- -	NA	- -
		Dermal Contact	2.E-05	- -	cPAHs	Arsenic	NA	- -
		Total	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
	Groundwater	Ingestion	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
		Dermal Contact	2.E-07	- -	- -	- -	NA	- -
		Total	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
		Total Surface Soil	1.E-04	- -	- -	- -	NA	- -
		Total Groundwater	1.E-04	- -	- -	- -	NA	- -
		Total Across the Entire Site	**2.E-04**	- -	- -	- -	NA	- -

cPAHs = Carcinogenic PAHs
NA = Not applicable

TABLE 6-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 19 - SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Construction/Excavation Worker	Surface Soil	Ingestion	8.E-08	- -	- -	- -	0.3	- -
		Dermal Contact	9.E-09	- -	- -	- -	0.005	- -
		Inhalation	3.E-09	- -	- -	- -	0.02	- -
		Total	9.E-08	- -	- -	- -	0.3	- -
	Subsurface Soil	Ingestion	5.E-08	- -	- -	- -	0.2	- -
		Dermal Contact	3.E-09	- -	- -	- -	0.004	- -
		Inhalation	3.E-09	- -	- -	- -	0.02	- -
		Total	6.E-08	- -	- -	- -	0.2	- -
	Groundwater	Ingestion	NA	- -	- -	- -	NA	- -
		Dermal Contact	5.E-10	- -	- -	- -	0.0007	- -
		Total	5.E-10	- -	- -	- -	0.0007	- -
		Total Surface Soil	9.E-08	- -	- -	- -	0.3	- -
		Total Subsurface Soil	6.E-08	- -	- -	- -	0.2	- -
		Total Groundwater	5.E-10	- -	- -	- -	0.0007	- -
		Total Across the Entire Site	**1.E-07**	- -	- -	- -	**0.5**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Maintenance Worker	Surface Soil	Ingestion	2.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0008	- -
		Total	2.E-06	- -	- -	- -	0.07	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.07	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.07**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Occupational Worker	Surface Soil	Ingestion	2.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0008	- -
		Total	2.E-06	- -	- -	- -	0.07	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.07	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.07**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adolescent Trespasser	Surface Soil	Ingestion	2.E-07	- -	- -	- -	0.007	- -
		Dermal Contact	2.E-08	- -	- -	- -	0.0002	- -
		Total	2.E-07	- -	- -	- -	0.007	- -
		Total Surface Soil	2.E-07	- -	- -	- -	0.007	- -
		Total Across the Entire Site	**2.E-07**	- -	- -	- -	**0.007**	- -

TABLE 6-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 19 - SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Child Resident	Surface Soil	Ingestion	4.E-06	- -	- -	Arsenic	0.7	- -
		Dermal Contact	2.E-07	- -	- -	- -	0.007	- -
		Total	4.E-06	- -	- -	Arsenic	0.7	- -
	Groundwater	Ingestion	4.E-06	- -	- -	Arsenic	0.09	- -
		Dermal Contact	1.E-08	- -	- -	- -	0.0002	- -
		Total	4.E-06	- -	- -	Arsenic	0.09	- -
		Total Surface Soil	4.E-06	- -	- -	- -	0.7	- -
		Total Groundwater	4.E-06	- -	- -	- -	0.09	- -
		Total Across the Entire Site	**8.E-06**	- -	- -	- -	**0.8**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Adult Resident	Surface Soil	Ingestion	1.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	8.E-08	- -	- -	- -	0.0008	- -
		Total	1.E-06	- -	- -	- -	0.07	- -
	Groundwater	Ingestion	7.E-06	- -	- -	Arsenic	0.14	- -
		Dermal Contact	2.E-08	- -	- -	- -	0.0005	- -
		Total	7.E-06	- -	- -	Arsenic	0.14	- -
		Total Surface Soil	1.E-06	- -	- -	- -	0.07	- -
		Total Groundwater	7.E-06	- -	- -	- -	0.14	- -
		Total Across the Entire Site	**8.E-06**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Total Residential Risks	Surface Soil	Ingestion	5.E-06	- -	- -	cPAHs, Arsenic	NA	- -
		Dermal Contact	3.E-07	- -	- -	- -	NA	- -
		Total	5.E-06	- -	- -	cPAHs, Arsenic	NA	- -
	Groundwater	Ingestion	1.E-05	- -	- -	Arsenic	NA	- -
		Dermal Contact	3.E-08	- -	- -	- -	NA	- -
		Total	1.E-05	- -	- -	Arsenic	NA	- -
		Total Surface Soil	5.E-06	- -	- -	- -	NA	- -
		Total Groundwater	1.E-05	- -	- -	- -	NA	- -
		Total Across the Entire Site	**2.E-05**	- -	- -	- -	NA	- -

cPAHs = Carcinogenic PAHs

TABLE 9.1. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CONSTRUCTION WORKER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-08		1.6E-08	5.6E-08	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	4.6E-02			4.6E-02
			ARSENIC	1.2E-07	1.9E-10	1.1E-08	1.3E-07	ARSENIC	Skin, CVS	1.6E-01	1.8E-03	1.5E-02	1.8E-01
			BARIUM					BARIUM	Kidney		3.8E-04		3.8E-04
			CHROMIUM		5.9E-09		5.9E-09	CHROMIUM	Fetotoxicity/GS/Bone	2.5E-02	4.3E-04		2.5E-02
			COBALT		3.1E-10		3.1E-10	COBALT	CVS, Immunological, Neurological	1.2E-01	3.5E-03		1.2E-01
			IRON					IRON	Gastrointestinal System	1.4E-01			1.4E-01
			MANGANESE					MANGANESE	CNS	2.5E-02	4.0E-02		6.6E-02
			NICKEL		2.4E-11		2.4E-11	NICKEL	Body Weight		6.2E-04		6.2E-04
Soil	Subsurface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	8.1E-10		3.2E-10	1.1E-09	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	3.2E-02	3.6E-03		3.5E-02
			ARSENIC	1.0E-07	1.6E-10	9.0E-09	1.1E-07	ARSENIC	Skin, CVS	1.3E-01	1.5E-03	1.2E-02	1.5E-01
			CHROMIUM		4.6E-09		4.6E-09	CHROMIUM	Fetotoxicity/GS/Bone	2.0E-02	3.4E-04		2.0E-02
			COBALT		3.1E-10		3.1E-10	COBALT	CVS, Immunological, Neurological	1.2E-01	3.5E-03		1.3E-01
			IRON					IRON	Gastrointestinal System	1.1E-01			1.1E-01
			NICKEL		2.4E-11		2.4E-11	NICKEL	Body Weight		5.9E-04		5.9E-04
			MANGANESE					MANGANESE	CNS	2.0E-02	3.2E-02		5.3E-02
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)					BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC			1.1E-09	1.1E-09	ARSENIC	Skin, CVS			1.5E-03	1.5E-03

Total Risk for Surface Soil	1.9E-07	Total HI for Surface Soil	0.6
Total Risk for Subsurface Soil	1.1E-07	Total HI for Subsurface Soil	0.5
Total Risk for Groundwater	1.1E-09	Total HI for Groundwater	0.0015
Total Risk Across All Media and All Exposure Routes	3.E-07	Total HI Across All Media and All Exposure Routes	1.E+00

Total Immune System HI =	0.3	Total Gastrointestinal HI =	0.3
Total Skin HI =	0.3	Total Kidney HI =	0.0004
Total CVS HI =	0.6	Total Fetotoxicity & Bone HI =	0.05
Total Neurological HI =	0.3	CNS HI =	0.2
Body Weight =	0.001		

TABLE 9.1a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CONSTRUCTION WORKER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	2.0E-08		5.3E-09	2.5E-08	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	2.3E-02			2.3E-02
			ARSENIC	6.0E-08	9.5E-11	3.6E-09	6.3E-08	ARSENIC	Skin, CVS	8.1E-02	9.0E-04	4.8E-03	8.7E-02
			BARIUM					BARIUM	Kidney		1.9E-04		1.9E-04
			CHROMIUM		2.9E-09		2.9E-09	CHROMIUM	Fetotoxicity/GS/Bone	1.2E-02	2.1E-04		1.3E-02
			COBALT		1.6E-10		1.6E-10	COBALT	CVS, Immunological, Neurological	6.1E-02	1.8E-03		6.2E-02
			IRON					IRON	Gastrointestinal System	7.1E-02			7.1E-02
			MANGANESE					MANGANESE	CNS	1.3E-02	2.0E-02		3.3E-02
			NICKEL		1.2E-11		1.2E-11	NICKEL	Body Weight		3.1E-04		3.1E-04
Soil	Subsurface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-10		1.1E-10	5.1E-10	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	1.6E-02	1.8E-03		1.8E-02
			ARSENIC	5.0E-08	8.1E-11	3.0E-09	5.3E-08	ARSENIC	Skin, CVS	6.7E-02	7.6E-04	4.0E-03	7.2E-02
			CHROMIUM		2.3E-09		2.3E-09	CHROMIUM	Fetotoxicity/GS/Bone	9.8E-03	1.7E-04		1.0E-02
			COBALT		1.6E-10		1.6E-10	COBALT	CVS, Immunological, Neurological	6.2E-02	1.8E-03		6.4E-02
			IRON					IRON	Gastrointestinal System	5.7E-02			5.7E-02
			NICKEL					NICKEL	Body Weight		3.0E-04		3.0E-04
			MANGANESE		1.1E-11		1.1E-11	MANGANESE	CNS	1.0E-02	1.6E-02		2.6E-02
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)					BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC			5.5E-10	5.5E-10	ARSENIC	Skin, CVS			7.4E-04	7.4E-04

Total Risk for Surface Soil	9.2E-08	Total HI for Surface Soil	0.3
Total Risk for Subsurface Soil	5.6E-08	Total HI for Subsurface Soil	0.2
Total Risk for Groundwater	5.5E-10	Total HI for Groundwater	0.0007
Total Risk Across All Media and All Exposure Routes	1.E-07	Total HI Across All Media and All Exposure Routes	0.5

Total Immune System HI =	0.1	Total Gastrointestinal HI =	0.2
Total Skin HI =	0.2	Total Kidney HI =	0.0002
Total CVS HI =	0.3	Total Fetotoxicity & Bone HI =	0.02
Total Neurological HI =	0.1	CNS HI =	0.1
Body Weight =	0.0006		